Report for 2004WI82G: Groundwater sustainability in a humid climate: Groundwater pumping, groundwater consumption, and land use change.

There are no reported publications resulting from this project.

Report Follows

Project ID: 2004WI82G

Title: Groundwater sustainability in a humid climate: Groundwater pumping, groundwater consumption, and land use change.
Project Type: Research
Focus Categories: Water Use, Groundwater, Management and Planning
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Abstract
Integration of groundwater use trends and forecasts with an evaluation of the sustainable yields of aquifers is necessary to convey principal concepts of hydrologic systems mass balance and base flow preservation to water-resource managers. Water use is a concern even in humid “water-rich” states, such as Wisconsin, where groundwater pumping causes severe declines in groundwater levels and reduces groundwater discharge to surface water.
In the proposed research, we will address relationships between groundwater use, land-use change, population change, and the sustainability of groundwater resources in a water-rich environment. The work will advance the process of integrating water-use data collection with the “science of water use” by evaluating accounting and estimating methods within research into the economic and social components that drive patterns of water use. We will identify methods of reporting and estimating water use, with associated error analysis, that provide data of a quality sufficient to improve groundwater flow models used to forecast impacts of pumping on hydrologic systems.
One objective of the proposed research is to identify causes of observed exponential growth in groundwater pumping. This will be accomplished by developing a detailed understanding of water demand, consumption, and return for two study areas. One location is a rapidly urbanizing and suburbanizing county that has experienced a four-fold increase in population with a seven-fold increase in groundwater pumping, with significant increases in manufacturing and service sector employment. The second county is predominantly rural and has much lower rates of growth in water use, population, and economic development.
This information will allow us to integrate a detailed temporal and spatial database of groundwater withdrawal with existing groundwater flow models, yielding a tool to assess societal demands for economic growth and development in the context of water-resources planning and aquifer sustainability. Proposals for industrial, agricultural, commercial, and residential development may then be evaluated in the context of competing societal uses for groundwater. Forecasts of future water levels and baseflow may be based on realistic

scenarios of land-use change, and consequently can be used by planners and managers to assess the impacts of land-use patterns on water resources.
We will also investigate the impact of current practice in Wisconsin for tracking groundwater use on estimates of groundwater use, and propose a model for collecting (and/or estimating) groundwater pumping and discharge data in the state. Project results will be of interest to communities across the Great Lakes region, where, although there is a seemingly abundant supply of fresh water from the Cambrian sandstone aquifer and the lakes themselves, local governments actively participate in regional efforts of ecosystem preservation and water-supply planning. Project results will also be framed within a series of specific recommendations regarding water use and water discharge reporting from well owners, leading to improved strategies for compiling, estimating and reporting water use by counties and economic sectors.

1. **Project Update:** Overview of your progress on this project during the past year.

We have compiled water-use, land-use, climate, and economic data for the two study areas, Sauk and Waukesha (Wisconsin) counties. The water-use data include records of pumping from private high capacity wells and municipal water utilities. The municipal water utility data came from annual utility reports filed with the Wisconsin Public Service Commission. Our database currently includes the following records for all municipal water utilities in Sauk and Waukesha counties:

1) Annual water sales in millions of gallons per year by category (residential, commercial, industrial) for the years 1988-2003.
2) Total water sold in millions of gallons per year for the years 1988-2003.
3) Total water pumped in millions of gallons per year for the years 1988-2003.

Private high-capacity well records in Sauk and Waukesha counties were obtained from the Wisconsin Department of Natural Resources. Each private high-capacity well record has been reviewed and assigned a water-use category that is consistent with the categories used in the annual utility reports. The available private high capacity well records do not contain sufficient information to estimate the water-use from these wells. Therefore, we have designed a stratified random sampling program to estimate the total annual pumpage from private high-capacity wells. We are in the early stages of this sampling program and have begun to request cooperation from well owners.

A GIS land-use dataset has been obtained for Waukesha County from the Southeastern Wisconsin Regional Planning Commission. Because no equivalent dataset is available for Sauk County, we are planning to estimate historical land-use trends in Sauk County using tax parcel records.

Historical records of temperature, precipitation, and growing degree days from weather stations in Sauk and Waukesha counties were obtained from the Midwestern Regional Climate Center. Population and economic data were obtained from the U.S. Bureau of Economic Analysis. We are in the preliminary stages of data analysis and have begun looking for correlations between municipal water-use and land-use, climate, and/or economic factors.